Outreach
Warnell School of Forestry & Natural Resources
UNIVERSITY OF GEORGIA

Results and Recommendations from Longleaf Interplanting Trials in Georgia

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Interplanting Background

Interplanting loblolly (*Pinus taeda*) in loblolly planted stands or interplanting slash (*Pinus elliottii*) in slash planted stands has been mostly unsuccessful. Interplanting consists of planting seedlings in spots where seedlings have died in the first growing season. In most interplanting cases seedlings (usually the same species) are planted during the dormant season following the first growing season of the originally planted seedlings. Some landowners have interplanted their stands in March with the original planted seedlings having been planted in December –February. The first slash pine symposium literature (1983) recommends if interplanting is done at all, plant one seedling in the middle of a 30-40 foot run of no living seedlings. Replanting ¼ acre or larger areas of no or very poor survival (less than 20%) has proven somewhat successful. Some landowners have interplanted faster growing loblolly in their slash or longleaf (*Pinus palustris*) stands in planting spots where seedlings have died after one growing season. Typically the interplanted seedlings, already one year behind the surviving original seedlings, are smaller in height and diameter after their first growing season than the original seedlings and this trend of being behind in height and diameter growth continues into canopy closure.

Longleaf Interplanting Studies Background

The University of Georgia installed four longleaf interplanting trials in three moderate to high fertility former old-field sites and a lower fertility former pasture site in Georgia where longleaf seedlings were planted but survival was at or below 70% (typically 40-60% survival) after the first growing season. All sites were originally planted with containerized seedlings at a 6 x 12 feet spacing (605 trees/acre). The University of Georgia Warnell School faculty and technicians and UGA CAES Extension County agents planted one (1-0) and two-year-old (2-0) longleaf seedlings in every planting spot where there was a dead seedling and followed these interplanting sites for three to 15-years for survival, height and diameter (dbh = diameter at breast height 4.5 feet above groundline). On three of the four sites, three rows of 1-0 seedlings (approximately 50 planting spaces/row) were planted then three rows of 2-0 seedlings were planted for three replications of each seedling age interplanting treatment in dead seedling spots. The fourth site had only 1-0 seedlings planted in four rows of every spot where there was a dead seedling in 27 plots (three replications of nine post-plant herbaceous weed control treatments). The longleaf interplanting studies were installed in Bryan (Kershaw soil series; excessively well drained deep sandy soil, former pasture; 1953 sprigged in Bermudagrass), Emanuel (well drained Tifton soil, formerly in cotton, corn soybeans and a winter grain), northwest Laurens (well drained Fuquay soil, former old field), and southeast Laurens County (well drained Bonneau soil, former old field). All interplanted containerized longleaf seedlings were planted with 6” tube dibbles in Dec-Jan after the first growing season at each site. All interplanted seedlings were color wire flagged while planting (white for 2-0 and green, orange or red for 1-0).

Interplanting Studies – Results

The northwest Laurens County, Georgia old-field planted longleaf site

One-year-old interplanted seedlings averaged 4.5 feet while the original planted seedlings averaged 9.0 feet. The 1-0 interplanted seedlings averaged 63% survival, while the original planted seedlings had 4% mortality after year one through the fifth year (4 years after the interplanting was done). Figures 1 and 2 illustrate height comparisons (and dead spots from the interplant dying) after 5-years from the original planting.

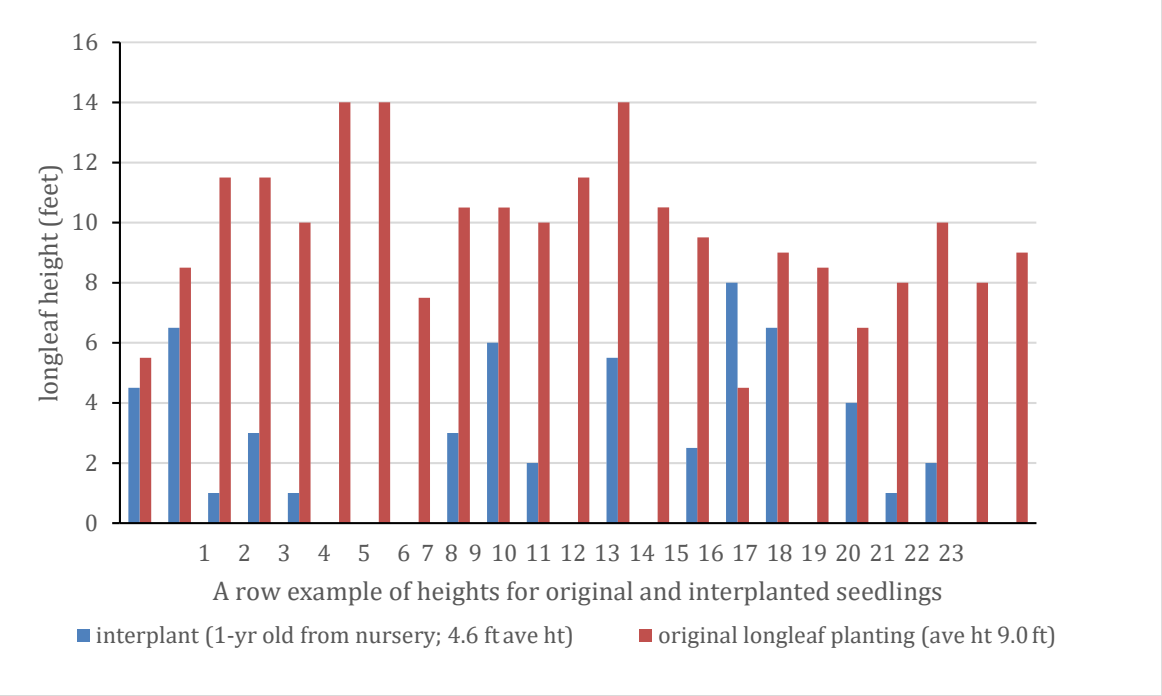

Figure 1. Old-field longleaf interplant study using 1-yr old seedlings from the nursery (1-0 seedlings) 5 years after the original planting (4 years after the interplanting) in northwest Laurens County, Georgia.

Note the interplant heights next to the original planted heights in Figure 1. Average heights were 9.0 feet for the original planted longleaf seedlings and 4.6 feet for the interplants (1-0 seedlings). Eight of the 23 interplants died after four years (65% interplant survival).

Figure 2 shows the average heights of the original planted seedling rows were 9.3 feet compared to 5.0 feet for the 2-0 interplants after 5 years. Ten of 25 interplants died in the 4 years after planting the 2-0 seedlings (60% survival).

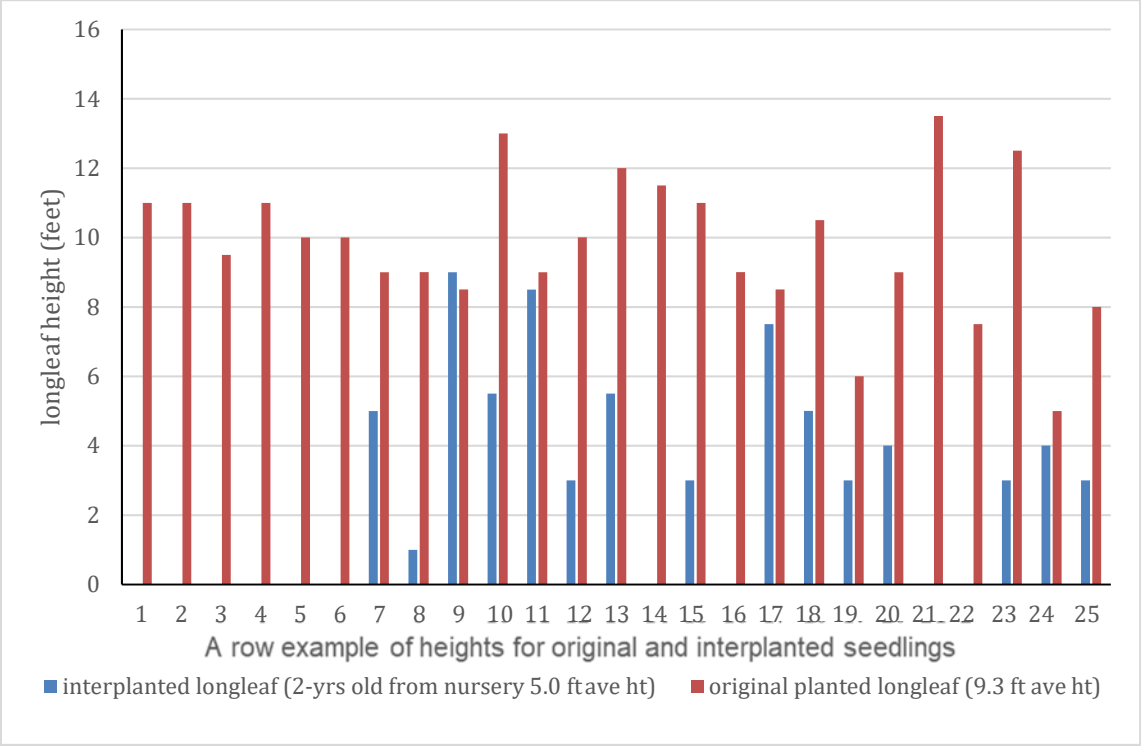

Figure 2. Old-field longleaf interplant study using 2-yrs old from the nursery (2-0 seedlings) after 5 years after the original planting (4 years after the interplanting) in northwest Laurens County, Georgia.

The southeast Laurens County, Georgia interplant study

The southeast Laurens County, Georgia study had similar outcomes as the northwest Laurens County, Georgia study. The original seedlings averaged 11.0 feet tall after 4 years while the average height for the 1-0 interplanted seedlings was 5.0 feet and the 2-0 interplanted seedlings average height was 5.5 feet (Figures 3 and 4). These interplanted seedlings survived better than those planted at the northwest Laurens County site, but were ½ to less than ½ the height of the original planted longleaf seedlings at the end of the fifth year after the original planting (fourth year from the interplanting).

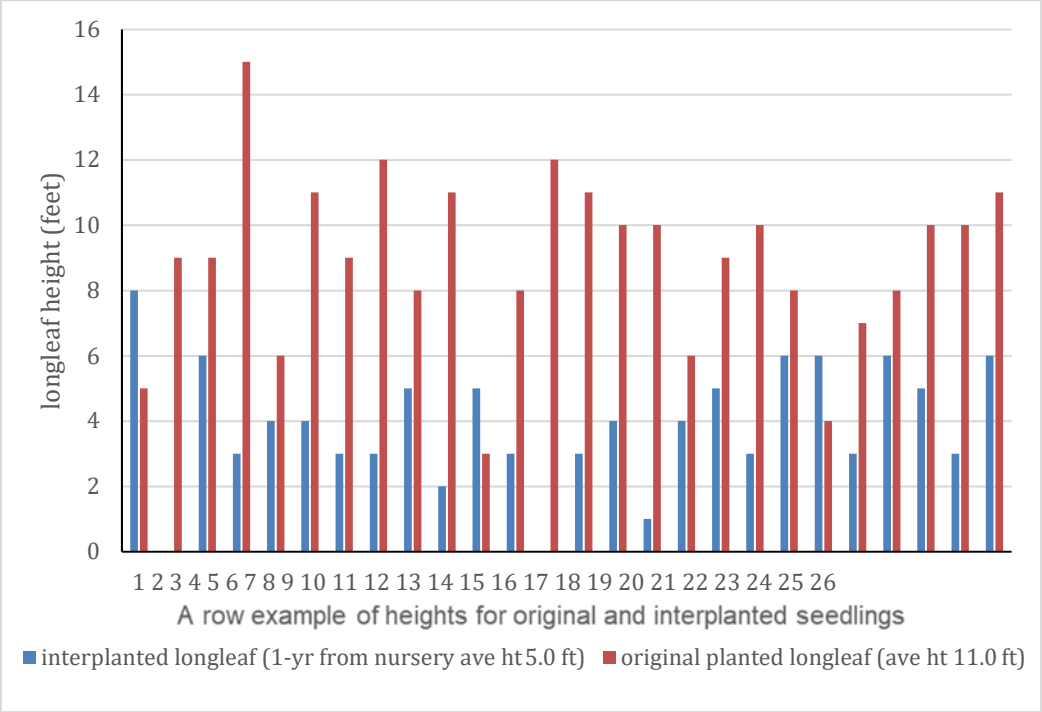

Figure 1. Old-field longleaf interplant study using 1-yr from nursery (1-0 seedlings) 5 years after the original planting (4 years after the interplanting) in southeast Laurens County, Georgia.

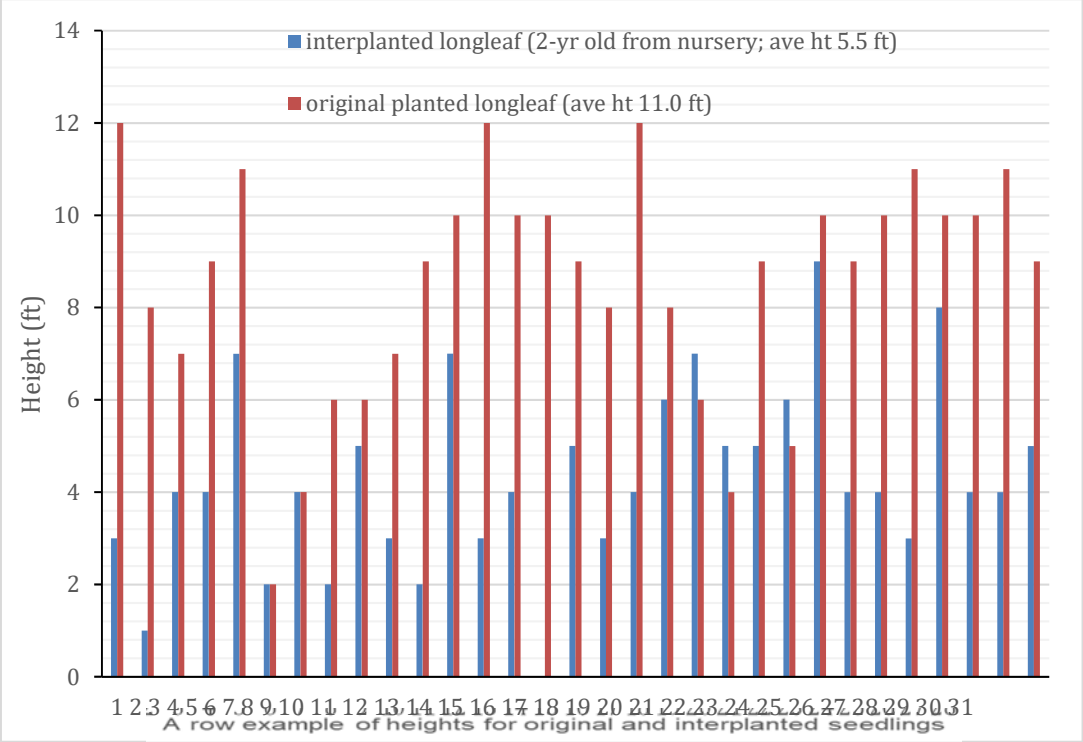

Figure 4. Old-field longleaf interplant study using 2-yr old from nursery (2-0 seedlings) 5 years after the original planting (4 years after the interplanting) in southeast Laurens County, Georgia.

Bryan County, Georgia interplant study

The Bryan County interplant study had the poorest survival and growth of the original planted and interplanted longleaf sites due to the soil texture (sand), drainage (excessively well drained), and low water and nutrient holding capacity. First year survival of the original planted containerized seedlings was 60%. First year interplant survival of the 1-0 and 2-0 seedlings was 45%. Figure 5 illustrates that very few (less than 10%) interplant seedlings survived to age 3 years. The original planted seedlings' mortality after year 1 was low, approximately 10%. Average height for the original planted longleaf seedlings was 2.7 feet and the 1-year-old nursery seedlings averaged 0.75 feet for the few that survived.

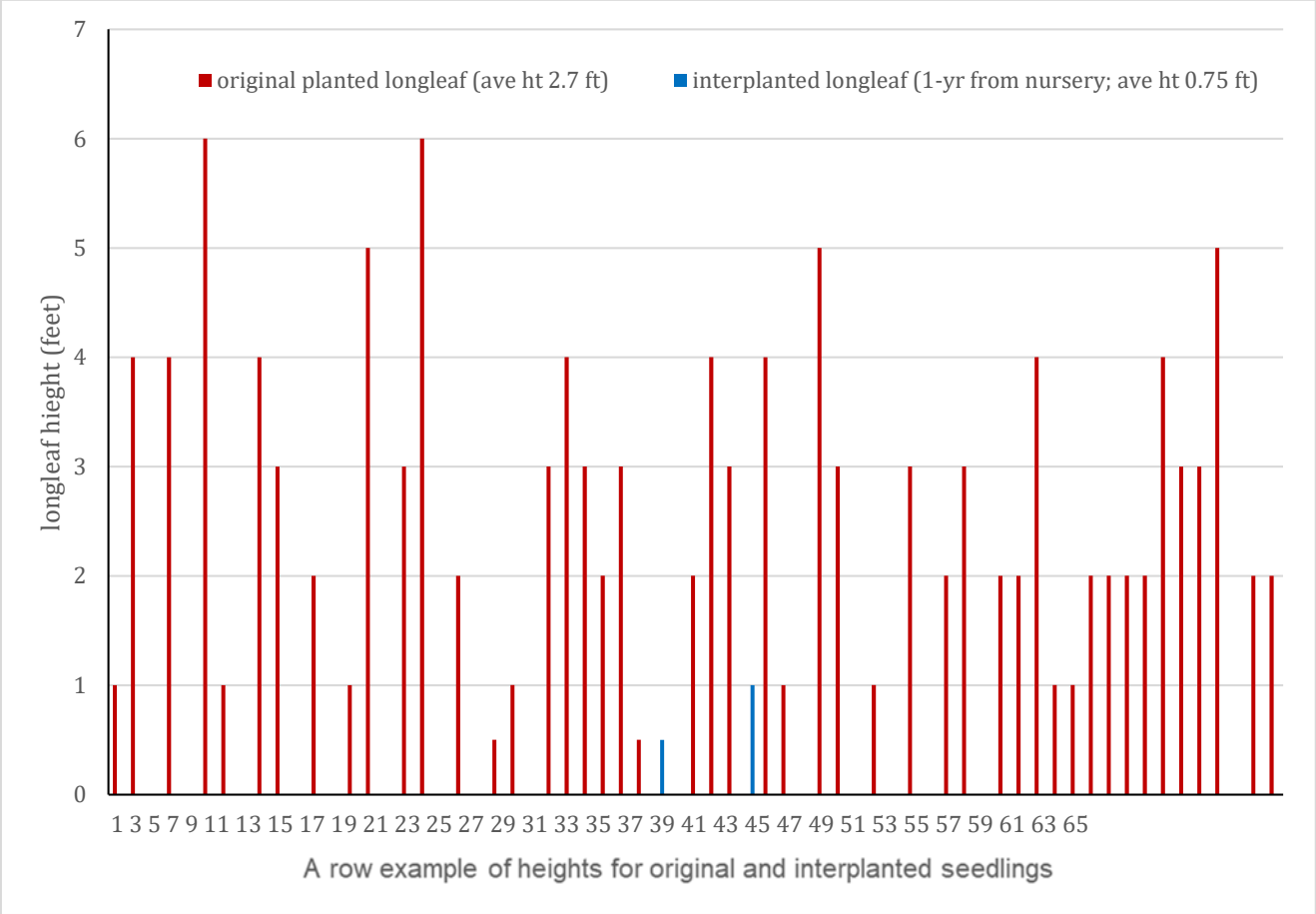

Figure 5. Former Bermudagrass pasture, Kershaw deep sand longleaf interplant study using 1-0 seedlings from the nursery 4 years after the original planting (3 years after interplanting) in Bryan County, Georgia.

Photos 1 and 2. The northwest Laurens County, Georgia longleaf pine interplanting trial with the 2-0 stock longleaf interplanted seedlings (left photo) compared to the original longleaf seedlings height 3 years after the original planting and 2 years after interplanting.

Photos 3 and 4. The southwest Laurens County, Georgia longleaf interplanting trial with the 10 longleaf interplanted tree (left photo) between two original planted longleaf pines. The right photo depicts a 2-0 longleaf interplant with a larger original tree located to the right. Photos were taken 3 February 2017.

Photos 5 and 6. The Bryan County, Georgia longleaf pine interplant trial was located on a former Bermudagrass pasture and contained an excessively well drained deep sand Kershaw soil series with low fertility. The original planted longleaf trees averaged 2.7 feet in height and had a 50% survival rate. The interplants (both 1-0 and 2-0seedlings) averaged 45% survival after 1 year and less than 10% survival 3 years after planting. Those that survived three years after planting averaged 0.75 feet tall. Orange flags denote rows (double flagged) and planting spots (single flagged) where a 1-0 seedling was planted. Single white flags denote where a 2-0 longleaf seedling was planted. Photos were taken during January 2017, 4 years after the original planting and 3 years after interplanting.

Emanuel County, Georgia herbaceous weed control and interplanting trial

The old-field longleaf pine seedlings were planted during December 1999 on a well-drained Tifton soil series. Due to a very dry first April and May (1.5 inches of rain in those two months, historically 7+ inches in April and May) end of first year survival was low averaging 50% in the early May herbaceous weed control plots. All longleaf seedlings in each plot were color wire flagged and numbered (aluminum tree tag) at the beginning of their first growing season. Dead longleaf seedling spots were interplanted in December 2000. These interplants had a second wire flag to denote that they were interplants. Six growing seasons after the original planting, (5 growing seasons after interplanting) the original trees averaged 16.0 feet tall and 3.5 inches dbh while the interplants averaged 9.0 feet tall and 1.6 inches dbh. We returned to the study area in April 2017 to re-measure the original trees and the interplants that survived. Figures 6 and 7 illustrate the height and diameter differences between the original trees and the interplants. Forty-two percent of the interplants had died in the last two plus years (estimated based on no needles on these trees and bark sloughing off the stem) due to their lower canopy positions and not being able to compete for resources with the larger, taller original planted seedlings (now trees). The diameter (dbh) classes for the living interplants ranged from 3 to 6 inches with most in the 5 inch class. The diameter classes for the original planted longleaf ranged from 6 to 11 inches with over 50% in the 9 to 11 inch classes (Figure 6). The average diameter for the interplants was 5.0 inches and the original seedlings was 9.0 inches as of early April 2017 (Figure 6). The height classes for the interplant longleaf ranged from 30 to 40 feet while the original planted longleaf heights ranged from 45 to 55 feet (Figure 7). Average height for the interplants was 35 feet while the original planted longleaf was 50 feet tall as of early April 2017. On average there were approximately 415 trees/acre; 350 were original trees and 65 were interplants.

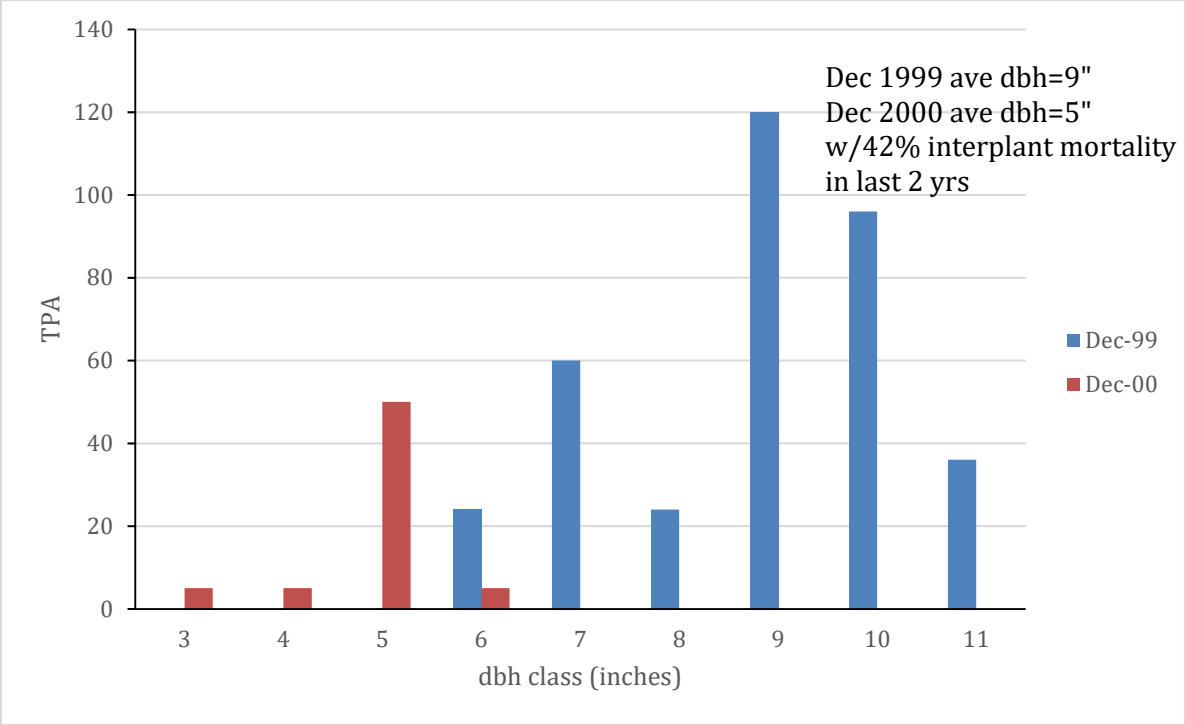

Figure 6. Trees per acre by dbh class are presented for the Emanuel County, Georgia old-field December 1999 vs December 2000 (interplants) planted containerized longleaf study site (as of 5 April 2017).

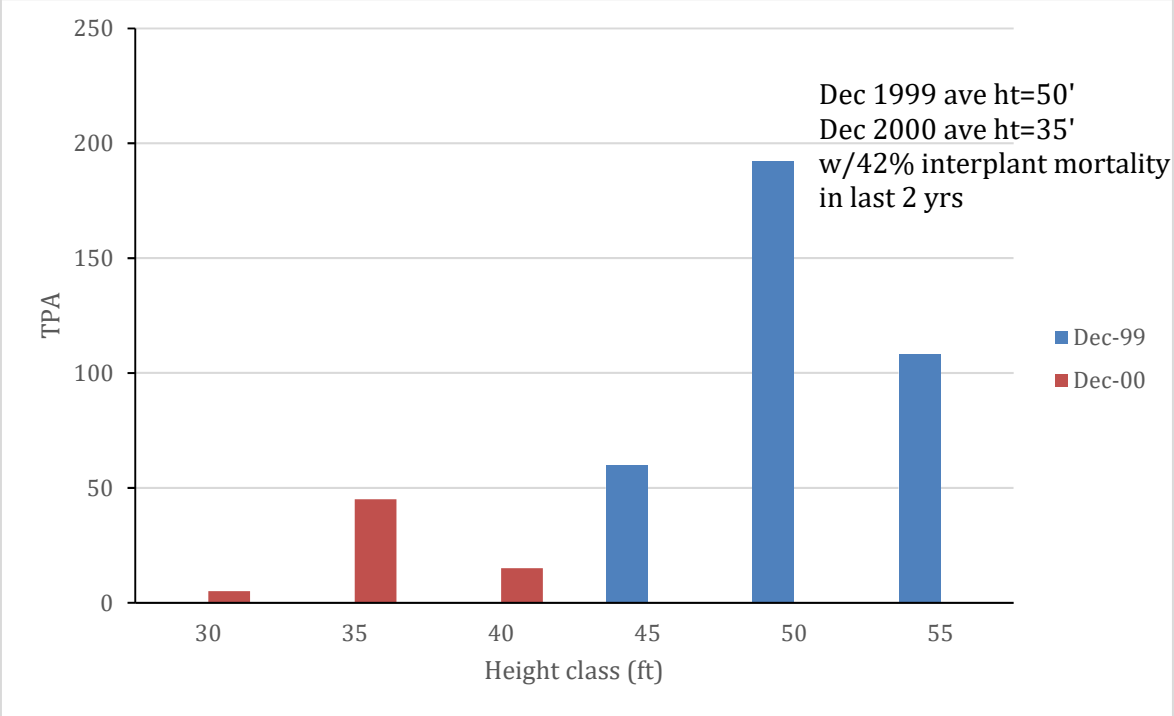

Figure 7. Emanuel County, Georgia old-field planting December 1999 vs December 2000 (interplants) planted containerized longleaf number of trees per acre by height classes (as of 5 April 2017)

Photos 7 and 8. Emanuel County, Georgia longleaf herbaceous weed control and interplanting trial 17 years after the original planting (16 years after the interplanting) illustrating the small or dead interplants in the plots compared to the larger diameter original planted longleaf pines. Photos taken early April 2017.

Summary

Based on these four longleaf interplanting studies (planting at the end of first growing season in the rows where seedlings had died); interplanting does not seem to make economic or biological sense. Many of the longleaf interplants have died (40% on three of the four sites to 90% on the poorest site) and those that are still living are small in diameter and height compared to the original planted trees. We do not recommend interplanting longleaf seedlings one year after the original planting. Sites with very low (less than 25-30%) end of first year survival should be replanted along the original rows at the end of the first year, maybe as early as September-October if soil moisture is good.

Recommendations

We recommend that (1) very good pre-plant site preparation using labeled herbicides specific to longleaf plantings and for on-site woody and herbaceous plant composition be performed. (2) Order longleaf seedlings early, do research on the seedlings available, and plant containerized seedlings as early as late September if soil moisture is good. As long as soil moisture is good for planting early plantings survive better and grow faster than late plantings almost every year. Try to be done planting by mid-February. (3) Plant more trees/acre than is practiced with loblolly pine stand establishment. Plant 726 (6x10 feet) or more seedlings if cost share programs allow it. (4) Perform first year herbaceous weed control over the top of the longleaf seedlings (4, 5 or 6 foot band is fine) using labeled herbicides for over the top of longleaf pine (Oustar @ 10-12 oz/ac as long as soil pH is less than 6.1) in early April (for South Georgia) to improve survival and growth in a dry spring-summer or to improve growth in a good rainfall first year.

Literature Cited:

Stone, E.L. 1983. The managed slash pine ecosystem symposium: proceedings. 1981 June 9-11; Gainesville, FL. The University of Florida, Gainesville, FL. 434 p.